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Amendments to the Specification

The paragraph starting at page 1, line 10 has been amended as follows.

The present invention relates to a printing apparatus and method for a printer, a copy machine, ~~a~~ facsimile terminal equipment, or the like, and specifically, to correction of the deviation of a printed position resulting from an error in transportation of a printing sheet.

The paragraph starting at page 2, line 13 has been amended as follows.

In the figure, a printing head 7 mounted in a carriage portion 5 executes a scanning operation in a direction perpendicular to the drawing sheet, and during the scanning operation, ejects ink for performing a printing operation. In relation to the printing area covered by the printing head, a printing sheet P is transported, under the carriage portion 5, from right to left in the figure ~~with~~ while substantially ~~keeping~~ maintaining its horizontal ~~position~~ orientation. More specifically, as the above-stated two pairs of transportation mechanisms, a pair of a transportation roller (hereinafter referred to as "LF roller") 36 and a pinch roller 37 is provided ~~in~~ at an upstream side of the printing area, in which the printing sheet is transported, and a pair of a sheet discharging roller 41 and a spur 42 is provided ~~in~~ at a downstream side of the printing area. Among these rollers, the pinch roller 37 is rotatably supported on a rotation shaft provided in a pinch roller holder 30. The pinch roller holder 30 is urged by a pinch roller spring 31 so that the

pinch roller 37 can be pressed against the transportation roller 36. A pressing mechanism (not shown) similarly applies pressing force which is applied between the sheet discharging roller 41 and the spur 42. Thus, the print sheet is sandwiched between these two pairs of rollers. A motor (not shown) rotates the transportation roller 36, and rotationally drives the sheet discharging roller 41, which operates in connection with the transportation roller 36 via a predetermined gear train. Thus, the print sheet is transported a predetermined amount each time the print head performs a single scanning operation.

The paragraph starting at page 5, line 15 has been amended as follows.

Thus, the present invention ~~has~~ can have the following configuration:

The paragraph starting at page 9, line 5 has been amended as follows.

A printing apparatus according to this embodiment has an automatic sheet feeding unit installed therein, and in this state, has mechanism sections including the sheet feeding unit, a sheet transporting section, a sheet discharging section, a carriage section, and a cleaning section. Further, in addition to these mechanism sections, the printing apparatus is equipped with a control section in the form of a substrate which ~~control~~ controls an operation of each mechanism section, described later, and which executes processing for printing data, transportation of a printing sheet or the like. The control section has a CPU, a ROM, a RAM and others as in a case with well-known printing

apparatuses. Further, printing heads used in this printing apparatus are based on an ink jet method. Specifically, the printing heads employ what is called the BJ method which uses thermal energy generated by an electric-thermal transforming element to generate a bubble in ink to allow the ink to be ejected using pressure of the bubble.

The paragraph starting at page 9, line 24 has been amended as follows.

The mechanism sections are shown in Figs.1 to 3. Fig. ~~3~~ 1 is a front view of this printing apparatus, Fig. 2 is a side view thereof, and Fig. 3 is a traverse sectional view thereof. The above mentioned mechanism sections will be described below mainly with reference to the transverse sectional view of this printing apparatus shown in Fig. 3.

The paragraph starting at page 10, line 6 has been amended as follows.

In Fig. 3, the sheet feeding section 2 is constructed by installing the automatic sheet feeding unit in the printing apparatus main body. The automatic sheet feeding unit has a base 20, which is provided with a pressure plate 21 on which printing sheets P are loaded and a sheet feeding roller 28 that feeds the printing sheet P. The sheet feeding roller 28 has a D-shaped ~~cross section~~ cross-section formed by partially cutting a circle. The pressure plate 21 is equipped with a movable side guide 23 that can restrict the loaded position of the printing sheets P. The pressure plate 21 is rotatable around a rotating shaft formed on the base 20 so that the urging force of a pressure plate spring 212

can urge the printing sheets P loaded thereon toward the sheet feeding roller 28. Further, the pressure plate 21 and the movable side guide 23 have separating pads 213 (see Fig. 2) and 234 installed in sites thereof opposite to the sheet feeding roller 28 to prevent a plurality of printing sheets P from being fed ~~with~~ while overlapping each other, the separating pads being each composed of a material such as artificial leather which has a large friction coefficient.

The paragraph starting at page 11, line 10 has been amended as follows.

The automatic sheet feeding unit is equipped with a release cam gear 299 (see Fig. 4) to release the contact of the pressure plate 21 (or the printing sheets P loaded thereon) with the sheet feeding roller 28. Rotation of the gear is set so that when the pressure plate 21 lowers to a predetermined position, a cut portion 285 of the sheet feeding roller 28 is located opposite the separating pad 241. Thus, a predetermined space can be formed between the separating pad 241 and the sheet feeding roller 28. At the same time, the rotating roller 251 contacts with the separating pad 241 to prevent a plurality of printing sheets from being fed ~~with~~ while overlapping each other.

The paragraph starting at page 11, line 22 has been amended as follows.

As described above, in a standby state, the release cam gear 299 pushes the pressure plate 21 down to a predetermined position to clear the contact between the

pressure plate 21 and the sheet feeding roller 28 and between the separating pad 241 and the sheet feeding roller 28. Then, in this state, when driving force applied to drive a transportation roller 36 of the sheet transporting section 3, described later, is transmitted to the sheet feeding roller 28 and the release cam 299 via a gear or the like, the release cam 299 leaves the pressure plate 21, which is thus elevated to cause the sheet feeding roller 28 to contact with the printing sheet P. As the sheet feeding roller 28 rotates, the printing ~~sheet~~ sheets P are picked up and are then separated from one another by the separating pad 241 and fed to the sheet transporting section 3. Then, once the printing ~~sheets~~ sheet P has been fed into the sheet transporting section 3, the contact of the sheet feeding roller 28 with both the pressure plate 21 and the separating pad 241 is cleared by the release cam gear 299. Furthermore, once the fed printing sheet P has been completely printed and discharged, a return lever 26 acts on the printing sheets P placed on the separating pad 241 to allow the printing sheets P to be returned to their loaded position on the pressure plate 21.

The paragraph starting at page 13, line 25 has been amended as follows.

A plurality of pinch rollers 37, which follow each other, are provided so that they can contact with the transportation roller 36. The pinch rollers 37 are held by a pinch roller holder 30, and when the holder is urged by a pinch roller spring 31, the pinch rollers 37 ~~comes~~ come into pressure contact with the transportation roller 36 to generate force required to transport the printing sheet P. At this time, a rotating shaft of the pinch roller

holder 30 is mounted on a bearing of an upper guide 33 installed on the chassis 8, and the pinch roller holder 30 rotates around this shaft. The pinch roller holder 30 is integrally formed and has fixed or higher rigidity in a direction in which the printing sheets P are transported. By further setting relatively low rigidity in a direction perpendicular to the above transportation direction, the urging force of the pinch roller spring 31 appropriately acts on the pinch rollers 37. Further, all the pinch rollers 37 are constructed substantially parallel with the rotating shaft of the transportation roller 36 (see Fig. 1) as described above. The pinch roller holder 30 and the upper guide 33 also act as a guide for the printing sheets P. Furthermore, an inlet of the sheet transporting section 3, to which the printing sheet P is transported from the ~~above described~~ above-described sheet feeding portion 2, has a platen 34 disposed thereat to guide the printing sheet P. Further, the upper guide 33 is equipped with a PE sensor lever 35 that activates a PE sensor 32 for detecting front and back ends of the printing sheet P. Additionally, the platen 34 is mounted and positioned on the chassis 8. The pinch rollers 37 according to this embodiment are formed of resin such as POM which allows an object to slide well thereon, and each ~~have~~ has an outer diameter set between about ϕ3 and 7mm.

The paragraph starting at page 15, line 10 has been amended as follows.

A carriage portion 5, described later, is constructed above the sheet transporting section 3. The carriage portion has the printing heads 7 mounted thereon and which perform a scanning operation to eject ink to the printing sheet P for printing, the

printing sheet P being transported by the pair of the transportation roller 36 and the ~~punch~~ pinch roller 37 and the pair of the sheet discharging roller 41 and the spur 42. In this printing operation, the printing sheet P that has been fed to the sheet transporting section 3 is guided to the pair of the transportation roller 36 and the pinch roller 37 by the platen 34, the pinch roller holder 30, and the upper guide 33. At this time, the PE sensor lever is operated by the front end of the transported printing sheet P, to detect the front end of the printing sheet P. Then, based on the result of the detection, a printing position on the printing sheet P can be determined. Further, an LF motor 88 drives and rotates the pair of the rollers 36 and 37 to transport the printing sheet P on the platen 34, and the transportation roller 36 has an encoder wheel 361 (see Fig. 1) mounted thereon to detect the rotary position thereof. The encoder wheel 361 is composed of a disk-shaped transparent sheet having radial markings formed thereon at predetermined pitches. The rotary position or quantity of rotation of the transportation roller 36 can be determined when an optical encoder sensor 362 (see Fig. 1) fixed to the chassis 8 detects these marks.

The paragraph starting at page 16, line 10 has been amended as follows.

The carriage portion 5, as described before, has the printing heads 7 and ink tanks from which black and color inks are supplied to the printing heads 7, which are individually arranged for the respective ink colors and individually detachable from the carriage. Also as described above, the printing head 7 has a heater to heat the ink so that film boiling is caused in the ink to generate a bubble, and change in pressure caused by

~~grow~~ growth or ~~contract~~ contraction of the bubble causes the ink to be ejected from the nozzles of the printing heads 7. Thus, printing of an image on the printing sheet P can be performed. The printing heads 7 for the respective color inks have the nozzles, constituting printing elements, arranged parallel with the direction in which the printing sheet is transported. Thus, inoperative nozzles can be set and this setting can be used to execute corrections according to an error in transportation of the printing sheet, as described later with reference to Figs. 6B and 6C.

The paragraph starting at page 17, line 11 has been amended as follows.

Further, the carriage 50 is driven by a carriage motor 80 (see Fig. 1), which is mounted on the chassis 8, via a timing belt 83 (see Fig. 1). The timing belt 83 is extended and supported by idle pulleys 84 (see Fig. 1). Furthermore, the carriage 50 is equipped with a flexible substrate 56 (see Fig. 3) to transmit printing signals or the like, from an electric substrate 9 constituting the ~~above described~~ above-described control section, to the printing heads 7.

The paragraph starting at page 18, line 7 has been amended as follows.

The pair of the sheet discharging roller and spur in the sheet transporting section constitute a sheet discharging section. More specifically, a spur base 341 (see Fig. 1) has the spurs 42 rotatably provided therein correspondingly to the sheet discharging

rollers 41 and against which the spurs are contacted. The sheet discharging rollers 41 can be driven by ~~that~~ a transmission roller 40 ~~transmits~~ transmitting driving force for the transportation roller 36 to the sheet discharging roller.

The paragraph starting at page 18, line 16 has been amended as follows.

The sheet discharging rollers 41 ~~is~~ are formed as a plurality of roller portions, each of which is made of a high-friction material such as rubber, and is disposed on a shaft consisting of metal or resin (see Fig. 1). Further, each of the spurs 42 has a thickness of about 0.1 mm, has protrusions formed on its outer circumference, and is composed of a metal plate such as SUS (stainless steel) and a resin portion consisting of POM and forming a rotating bearing.

The paragraph starting at page 19, line 7 has been amended as follows.

With the above configuration, the printing sheet P on which printing has been carried out through a scanning operation of the printing heads of the carriage portion 5 is transported ~~with~~ while being held by nipping of the sheet discharging roller 41 and spur 42, and is then discharged to a sheet discharging tray or the like. During this transportation, once the back end of the printing sheet P has slipped out from the transportation roller 36 and the pinch roller 37, the printing sheet P is transported or discharged ~~with~~ while being held only by the sheet discharging roller 41 and spur 42 of the

sheet discharging section. Then, a printing operation is performed or the printing sheet is discharged. Further, a spur cleaner contacts ~~with~~ each of the spurs 42 to enable ink and the like deposited on the spur 42 to be removed.

The paragraph starting at page 19, line 24 has been amended as follows.

A cleaning section 6 (see Figs. 1 and 2) has a pump (not shown) used for an ejection recovery operation for the printing heads 7 and a cap (not shown) that restrains the ink in each nozzle of the printing head from drying.

The paragraph starting at page 20, line 4 has been amended as follows.

As described above, the transportation roller 36 has an encoder wheel 361 mounted thereon. Specifically, the encoder wheel 361 can be centered by press fitting it to the rotating shaft of the transportation roller 36, and is bonded to an LF pulley 364 to increase its strength. The encoder wheel 361 is, as shown in Fig. 4, a disk-shaped, ~~and~~ transparent sheet, and has radial markings formed thereon at predetermined pitches. With respect to the encoder wheel, an optical encoder sensor 362 is provided in a fixed state for detecting the markings on the encoder wheel 361 to determine the rotary position or quantity of rotation of the transportation roller 36. That is, each time any of the marks on the encoder wheel 361 reaches the position of the encoder sensor 362 as the transportation roller 36 rotates, a corresponding detection signal is generated and transmitted to the

control section. The control section counts the number of detection signals starting with a predetermined reference rotary position to determine the rotary position or quantity of rotation of the transportation roller 36. Further, the transportation roller 36 can be driven by transmitting the drive force of the LF motor 88 via a gear train.

The paragraph starting at page 21, line 8 has been amended as follows.

A printing operation performed by the ~~above-described~~ above-described printing apparatus of this embodiment, particularly an image position correcting operation, will be described with reference to Figs. 5 and 6.

The paragraph starting at page 22, line 23 has been amended as follows.

While the print sheet P is being transported, the above-mentioned pass switching is carried out when an image ~~formed~~ forming position reaches a "pass switching position", shown in Fig. 5. At this point of time, the print sheet P is sandwiched between the transportation roller 36 and the pinch roller 37. To allow image corrections to be executed at a "nip portion slip-out position", the pass switching must be carried out before the "nip portion slip-out position" is reached, in order to set correction nozzles on the downstream side of the print sheet in the transportation direction. Then, as described below, image corrections are executed on the basis of nip position information, described

later, stored in the storage means. Subsequent printing operations are performed after nozzle shifting as shown in Fig. 6C.

The paragraph starting at page 23, line 11 has been amended as follows.

During the normal printing shown in Fig. 6A, print heads 7 for black (Bk), cyan (C), magenta (M), and yellow (Y) each use all nozzles. Further, since the 4-pass printing is carried out, the quantity of transportation for the print sheet P per operation equals one-fourth of the total length of the nozzles. Then, this print area of the one-fourth width is entirely printed by causing the print heads to perform four scanning operations. This 4-pass area is entirely printed by executing the 4-pass printing while the print sheet P is being transported until the "pass switching position" of the print sheet P is reached. At the final stage of the printing of the 4-pass area, some nozzles of each print head are located opposite a 6-pass area. However, at this stage, the operative nozzles are shifted a distance corresponding to the quantity of transportation per operation to complete printing the 4-pass area without using the nozzles of each print head located opposite the 6-pass area. The switching of the number of passes is controlled in the above manner in order to ~~simply~~ simplify software, and it should be appreciated that the switching process is not limited to the above example.

The paragraph starting at page 25, line 9 has been amended as follows.

As shown in Fig. 7, during the printing operation, the control section determines the quantity of rotations of the transportation roller 36, on the basis of a signal from the encoder sensor 362. The control section also determines whether or not the back end of the print sheet P has been released from the nip portion between the transportation roller 36 and pinch roller 37, on the basis of the nip position information, described later, already stored in the storage means (step 1). If the control section determines that the back end has slipped out from the nip portion, the quantity of transportation for the print sheet P per operation, which quantity is used immediately after the determination, is set twice the quantity of transportation for the 6-pass printing (that is, the quantity equaling one-eighth of the length of the nozzle range), that is, the quantity is set to correspond to two-eighths of the all the nozzles (corresponding to two new-line operations).

The paragraph starting at page 27, line 13 has been amended as follows.

For the ~~above-described~~ above-described correcting operation, it is important to precisely determine whether or not the back end of the print sheet P has slipped out from the nip portion. To achieve this, the position of the nip portion in the transportation path must be precisely determined. Typically, as shown in Fig. 8, the position of the PE sensor lever 35, provided in the transportation path, is set as a reference so that the position of a nip portion 940 is determined on the basis of the distance A (Fig. 8) from the reference position to the nip portion 940.

The paragraph starting at page 28, line 3 has been amended as follows.

In this embodiment, when the PE sensor ~~detect~~ detects the back end of the print sheet, the speed of transportation is set at 20 mm/s for the image correcting operation and at 50 to 150 mm/s for the operations other than the image correcting operation.

The paragraph starting at page 29, line 17 has been amended as follows.

During this printing operation, the print sheet P is fed to a reflective photosensor 970 provided downstream of the print heads 7. The photosensor 970 sequentially reads the printed test pattern and transmits read data to the control section. The control section receives a test pattern signal output from the photosensor 970 to read the distance A from a printing start position corresponding to the passage of the back end of the print sheet P by the PE sensor lever 940 to the end of the white stripe (non-printed part) P0, which indicates that the printed sheet P has slipped out from the nip portion 940. The distance A is then written to the ~~EEPRPM~~ EEPROM as positional information on the nip portion 940 which has been obtained using the PE sensor lever 35 as a reference position (step 17). The print sheet P on which the pattern has been entirely printed is discharged from the sheet discharging roller 41 to a sheet discharging tray (not shown) (step 18), thereby completing the series of operations.

The paragraph starting at page 31, line 20 has been amended as follows.

In the first embodiment, individual nip position information obtained for each apparatus is obtained by printing the test pattern and reading the result of the printing. However, in this second embodiment, nip position information is obtained simply by transporting the sheet and without printing the test pattern or the like on the print sheet.

The paragraph starting at page 31, line 27 has been amended as follows.

Fig. 11 schematically shows the construction of the second embodiment. As shown in the figure, in the second embodiment, a pinch roller sensor 930 detects a variation in the position of the pinch roller holder 30 so that whether or not the back end has slipped out from the nip is determined on the basis of the result of the detection. The pinch roller sensor 930 is composed of a photosensor 970 having a floodlighting section and a light receiving section disposed with a predetermined clearance provided therebetween. Further, the pinch roller holder 30, supported for rotational movements by a rotational-movement support point 30b, has a detected ~~position~~ portion protruded from a side thereof. The detected portion 30a moves in between the floodlighting section and light receiving section of the pinch roller sensor 930 in accordance with rotational movement of the pinch roller holder 30.

The paragraph starting at page 33, line 14 has been amended as follows.

Thus, in this second embodiment, whether or not the back end of the print sheet P has slipped out from the nip between the transportation roller 36 and the pinch roller 37 can be determined by detecting a change in the position of the pinch roller 37. Further, whether or not the back end of the print sheet P has reached the PE sensor lever 30, i.e., the reference position, can be detected on the basis of an output from the PE sensor 32 as in the case with the first embodiment, described previously.

The paragraph starting at page 35, line 4 has been amended as follows.

That is, when the back end of the print sheet P slips out from the nip position 940 during a transportation operation, the transportation roller 36 rotates an extra distance according to the ~~back-lash~~ backlash as described previously. Thus, the encoder wheel 361 and the encoder sensor 362 are used to detect the quantity of rotations of the transportation roller during the intermittent transporting operation. If the detected quantity of rotations exceeds a normal value, it is determined that the back end of the print sheet P has slipped out from the nip portion. Then, nip position information (an interval A) can be obtained by counting the number of rotations after the PE sensor has detected the back end and before the print sheet P slips out from the nip portion.